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Retention of lobster (Homarus americanus) in three compartment wire traps as a function of escape mechanisms

by

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Abstract

Catch per unit of effort (CPUE) was used to test the significance of the second (hallway) compartment of a three compartment wire trap acting as a holding area for lobster trap regulation escape mechanisms (REM). The mechanisms were fitted to 36 wire traps in three experimental combinations (12 traps each): Type 2=REM on second compartment, Type 3=REM on third compartment, Type 4=REM on both the second and third compartment, 12 traps with no REM's were used as controls (Type 1). The CPUE's of the lobsters that are capable of escaping through regulation escape mechanisms (sub-retention size) were calculated by sex, for each trap type. The CPUE of male and total (male and female combined) groups of lobsters, of trap Types 1 and 2 were higher than that of Type 3 and 4, the CPUE of the female group showed different results which may have been behaviour related. In conclusion, the second compartment of Type 3 traps does not act as a holding area for the total sub-retention sized lobsters. These traps are also as efficient at releasing total sub-retention sized lobsters as are Type 4 traps.

Resume

La prise par unité d'effort (P.U.E.) de casiers à homard à trois compartiments a été calculée pour tester statistiquement le rôle du deuxième compartiment comme lieu de retention des homards. Sur trente-six de ces casiers, des évents (EE) ont été installés selon trois différentes combinaisons (12 casiers pour chacunes): Type 2=EE sur le deuxième compartiment; Type 3=EE sur le troisième compartiment; Type 4=EE sur le deuxième et le troisième compartiment. Douze casiers sans EE ont été utilisés comme contrôlés (Type 1). Les P.U.E. des homards peuvent théoriquement s'échapper du casier par un EE (homard de taille de sous-retention) ont été calculées en séparant les sexes, pour chacun des types de casiers. Les P.U.E. des groupes mâle et total (male et femelle) pour les casiers du Types 1 et 2 étaient significativement plus élevées que ceux des Types 3 et 4. Les P.U.E. du groupe femelle montrent des résultats qui different des autres groupes et peuvent être reliés à une différence de comportement. En conclusion, le deuxième compartiment des casiers du Type 3 n'agit pas comme lieu de retention pour tous (mâles et femelles) les homards de taille de sous-retention. De plus ces casiers ont une efficacité équivalente au casier de Type 4 en ce qui à trait au relâchement des homards de taille de sous-retention.

Introduction

The redesign and improvement of lobster traps has occured in conjunction with the development of the Canadian lobster (Homarus americanus) fishery. From the earliest years, researchers have made forays into the field of lobster trap design to evaluate function in reference to physical and behavioral constraints of the lobsters themselves (Templeman 1939, and Wilder 1943). Much work has also been done on lobster trap function in relation to escape mechanisms (Wilder, 1945; Templeman, 1958; and Krouse and Thomas, 1974).

In 1987 three compartment vinyl covered wire traps began to be used in greater numbers by lobster fishermen in the central Northumberland Strait, Fig. 1. The increased use of these wire traps coincided with the

holding compartment of all lobster traps (Table 1). The purpose of this escape mechanism is to release as many sublegal size lobsters (less than 63.5mm carapace length) as possible, thus avoiding damage to them as they are sorted out on the vessel.

It is the conventional method of the fisherman to put one regulation escape mechanism (REM) on the third compartment (parlor) of the three compartment wire traps. The Department of Fisheries and Oceans became concerned that the second compartment (hallway) could also function as a holding area, and requested that this concern be assessed.

The findings of this report shall determine if wire traps require REM's in the second compartment to facilitate sub-retention size lobster escapement. This study will not address the what effect, if any, hauling the trap to the surface may have on the compartment the lobsters are found.

Materials and Methods

This experiment compared the catch per unit of effort (CPUE) from experimental traps (utilizing various combinations of REM location and number on the trap) versus that of control traps without REM's for lobsters that are capable of escaping through REM's (sub-retention size).

The CPUE data was collected during the commercial lobster season by two lobster fishermen fishing the same lobster grounds off Pugwash, Nova Scotia. Twelve control traps and twelve traps of each of the three experimental designs were fished daily for a three week period at the end of the season. A total of 380 trap hauls per trap type, of one soak-over-day were used in subsequent calculations.

The following types of traps were used, the type number designated shall be used hereon:

Type 1 - Control trap, standard three compartment wire trap (first compartment = kitchen; second compartment = hallway; third compartment = parlor) without escape mechanisms, Figure 2;

Type 2 - Three compartment wire trap with a regulation size (38.1mm x 127mm plastic) escape mechanism fitted 60mm above the floor of the second compartment, Figure 2;

Type 3 - Three compartment wire trap with a regulation size (38.1mm x 127mm plastic) escape mechanism fitted 60mm above the floor of the third compartment, Figure 2;

Type 4 - Three compartment wire trap with a regulation size (38.1mm x 127mm plastic) escape mechanism fitted 60mm above the floor of both the second and third compartments, Figure 2.

The hauling bridle was attached to the first compartment end of all traps.

From previously completed studies on function of escape mechanisms (Maynard et al. 1987), it was determined that the use of a 38.1mm wide escape mechanism as in this study, would allow the escapement of up to 99.76% of the lobsters with a carapace measurement of 66.9mm or less. Therefore the lobsters retained for each trap type were sorted into two groups, the lobsters 66.9mm carapace length or less, that could have escaped if an escape mechanism was present, or 67.0mm and greater carapace length, which theoretically should have been retained. Furthermore these two groups were sorted into male, female, and total groups, since the mean carapace width of male and female lobsters are different (Gauthier and Hazel 1986, Maynard et al. 1987). It has been found that carapace width is the critical dimension for lobster escape using this type of escape mechanism (Nulk 1978). The results were accumulated and the catch per unit of effort (CPUE) for each trap type was calculated.

For each size group and sex we chose to use a test of multiple analysis of variance (Snedcor and Cochran, 1980), not only to determine if the CPUE was different for the control and each experimental type but also to determine the relationship between each. We chose the Duncan test which has protection against a Type 1 error and would therefore avoid the identify cation of an experimental trap design that really did not have significant differences from the others.

Results

The composition of the sub-retention catch of male and female lobsters in the experimental and control traps was as follows;

Trap Type	Number Males	Number Females
Type 1	43	45
Type 2	42	35
Type 3	18	34
Type 4	17	29

The results of the Duncan's test of multiple comparisons, at a level of 0.05 significance, for the CPUE for the sub-retention size groups total, males, and females are the following;

Total: The CPUE from Type 4 traps and Type 3 traps were not significantly different. The CPUE from Type 2 traps and Type 1 traps were not significantly different. But the CPUE for Types 4 and 3 were significantly less than the CPUE of Types 2 and 1 (Table 2, Fig. 4).

Male: The CPUE from Type 4 traps and Type 3 traps were not significantly different. The CPUE from Type 2 and Type 1 traps were not significantly different. But the CPUE for Types 4 and 3 were significantly less than the CPUE of Types 2 and 1 (Table 2, Fig. 4).

Female: The CPUE from Type 4 and Type 3 traps were not significantly different from each other. The CPUE from Type 2 traps could not be distinguished from the CPUE of trap Type 4 and 3 and Type 1. The CPUE of the Type 1 was however, significantly greater than the CPUE of Types 4 and 3 but not from Type 2, Table 2, Fig. 5.

Discussion

The results show that for the sub-retention size total and male lobsters, Type 2 traps (with a REM on the second compartment only) retain as many lobsters as Type 1 traps (without any REM). Type 4 traps (with REMs on both the second and third compartments) release as many lobsters as Type 3 traps do (with a single REM on the third compartment).

Female lobsters show different results, which might be the result of their behaviour in the presence of other lobsters. Another possible explanation for the higher female lobster CPUE in Type 3 and Type 4 traps could be that male lobsters have slightly narrower carapace widths than females (Gauthier and Hazel 1986, and Maynard et al. 1987). This suggestion is substantiated by the CPUE of trap Types 1 and 2 which showed little or no escape and had a sex ratio of 1 : 1 .

If we consider the total (male and female combined) CPUE of the experimental traps, the lobsters appear to pass through the second compartment, not taking advantage of any REM that was there and entering into the holding area of the third compartment. Once inside the third compartment, the lobsters made use of the REM, where their physical dimensions permitted. In conclusion, this study found that:

1. In three compartment wire traps with a rectangular escape mechanism on the conventional compartment (Type 3), the second compartment does not act as a holding area for the total sub-retention sized lobsters, regardless of the presence of an escape mechanism.

2. Traps with the conventional escape mechanism arrangement (Type 3) are equally efficient at releasing total sub-retention sized lobsters as are traps with escape mechanisms on the second and third compartment.

It is recommended that three compartment wire traps with regulation escape mechanisms on the third compartment do not require an escape mechanism on the second compartment to facilitate the escapement of sub-retention sized lobsters.

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We wish to thank the fisherman, Clifford Allen and Fred Brownell who participated in this project and Ron Munroe who assisted in the data collection. We wish to thank Elmer Wade for writing the custom computer programs and Daniel Ferron and Aaron Jones for providing constructive comments on this report. Yvon Chiasson and Sharon McGladdery reviewed this paper.

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TABLES

Table 1. Escape mechanisms are required by regulation to be one of the following two types, installed on the holding compartment of each lobster trap.

1 - Two unobstructed circular openings the diameter of each to be no less than 44.45mm diameter.
2 - One unobstructed rectangular opening with a length and width of no less than 38.1mm x 127mm, respectively.

Table 2. Multiple comparison analysis of CPUE of total sub-retention sized lobsters, where Type 4 is traps with escape mechanisms in the second and third compartment Type 3 is traps with an escape mechanism only in the third compartment Type 2 is traps with an escape mechanism only in the second compartment, and Type 1 is traps without escape mechanisms. Separation of significantly different trap types are denoted by different letters.

	Type 1		Type 2		Type 3		Type 4	
	Mean CPUE	Separation	Mean CPUE	Separation	Mean CPUE	Separation	Mean CPUE	Separation
Total	1.500	b	1.327	b	0.808	a	0.750	a
Male	0.788	b	0.731	b	0.288	a	0.288	a
Female	.788	b	0.596	ab	0.481	a	0.365	a

Figures

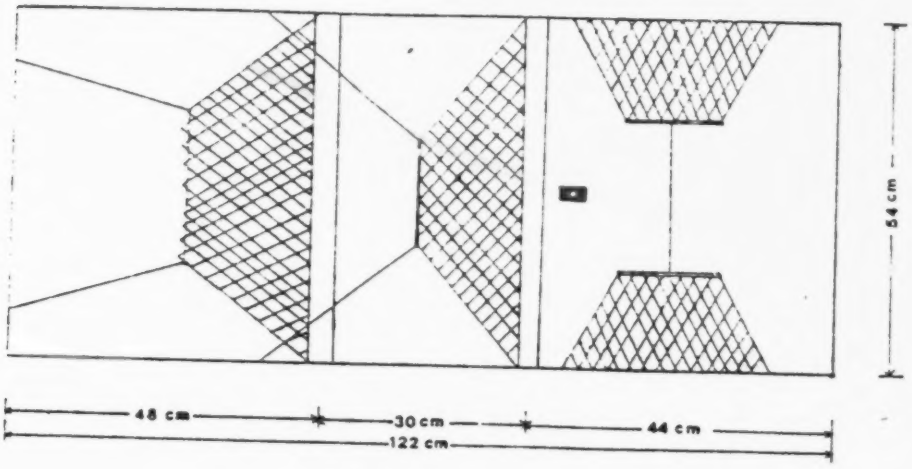
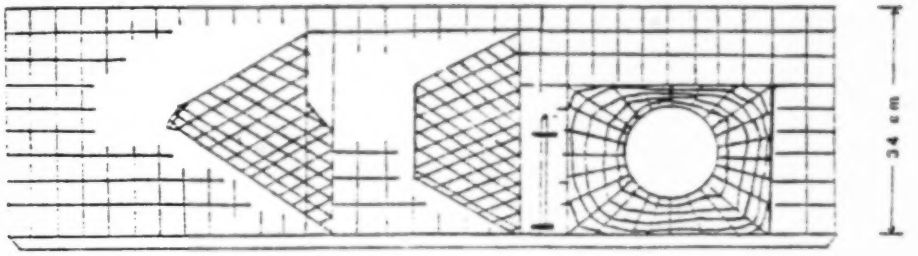
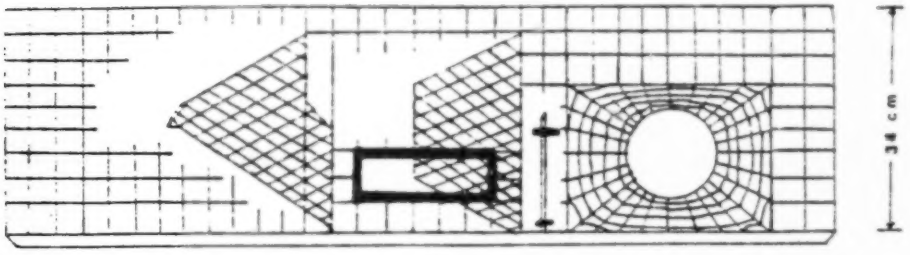


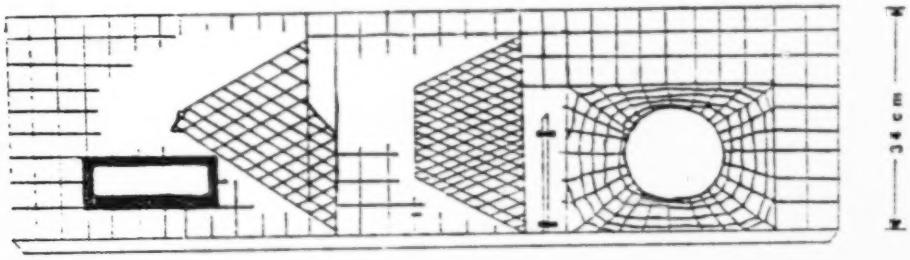
Fig. 1. Top view of three compartment (kitchen, hallway, and parlor) wire mesh trap. This trap has two ringed mesh entrances into the first compartment, one ringed meshed entrance from the first to the second compartment, and entry to the third compartment is through a "skate mouth" (Pecci et al. 1978) mesh entrance (no ring at the opening).



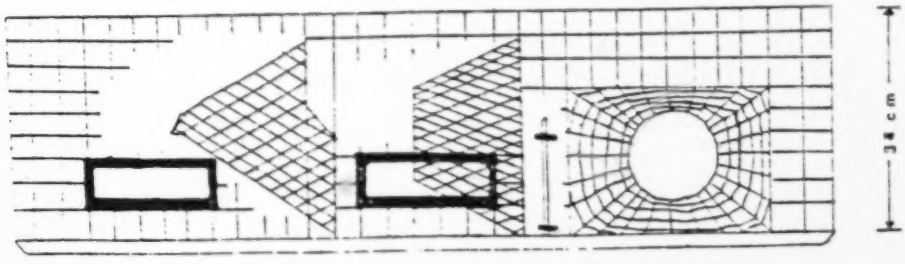
Type 1



Type 2



Type 3



Type 4

Fig. 2. Side view of three compartment wire mesh traps fitted with regulation (38.1mm x 127mm plastic) size escape mechanisms (used in this project).

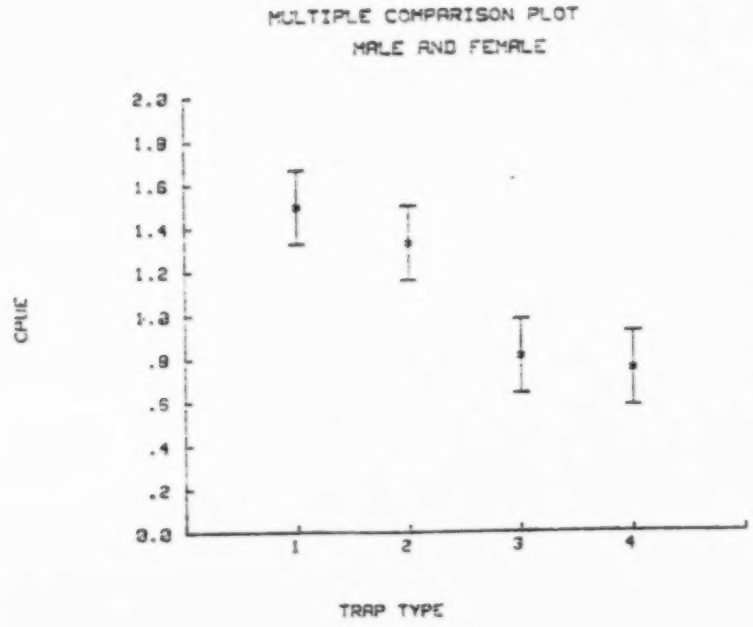


Fig. 3. Multiple comparison analysis of CPUE plot of sub-retention sized male and female lobsters combined (i.e. total sub - retention sized lobsters).

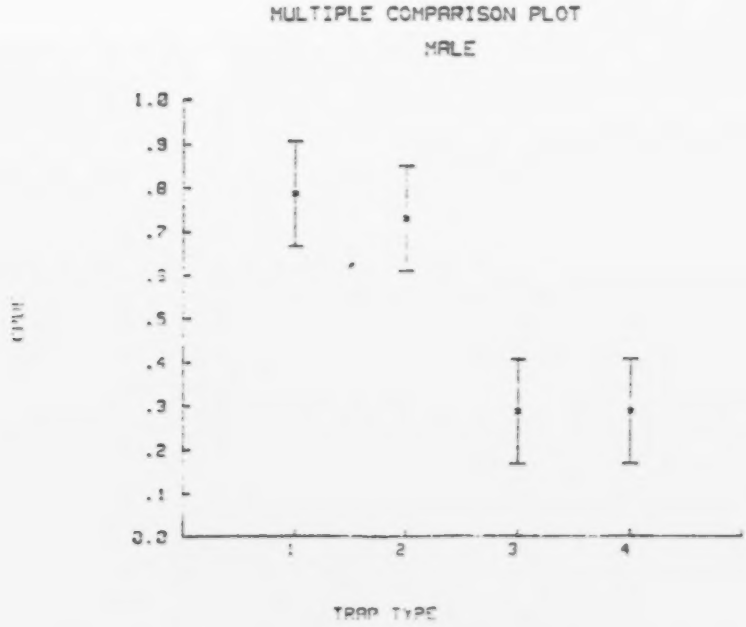


Fig. 4. Multiple comparison analysis of CPUE plot of sub-retention sized male lobsters.

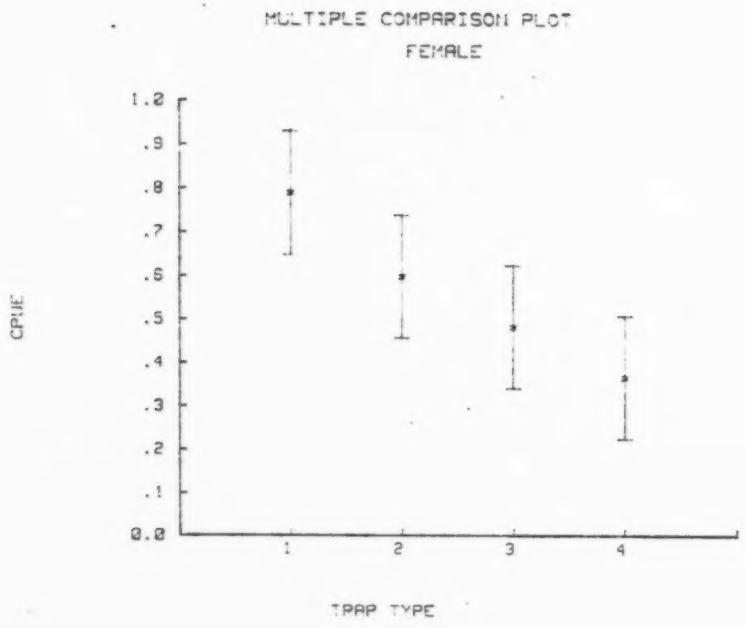


Fig. 5. Multiple comparison analysis of CPUE plot of sub-retention sized female lobsters.